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Eastern Pacific Species of the Venerid Genus *Cyclinella* (Bivalvia)

EUGENE V. COAN*

Department of Invertebrate Zoology and Geology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118-4599, USA

Abstract. In spite of the number of available names, there are only three eastern Pacific species of *Cyclinella.* (1) *Cyclinella jadisi* Olsson, 1961, occurs from the head of the Gulf of California to Guayas Province, Ecuador, from the intertidal zone to 31 m. (2) *Cyclinella producta* (Carpenter, 1856) occurs from Laguna Ojo de Liebre, Pacific coast of Baja California Sur, throughout the Gulf of California, to Tumbes Province, Peru, on intertidal mudflats; *C. singleyi* Dall, 1902, is a synonym. (3) *Cyclinella subquadrata* (Hanley, 1844) occurs from Isla Cedros, Pacific coast of Baja California, throughout the Gulf of California, to Lima Province, Peru, from the intertidal zone to 75 m. *Venus kroeyeri* Philippi, 1847; *Artemis macilenta* Reeve, 1850; *Arthemis saccata* Gould, 1851; *Cyclinella galera* Pilsbry & Olsson, 1941; and *C. kroeyeri ulloana* Hertlein & Strong, 1948, are regarded as synonyms of *C. subquadrata.* Other Recent taxa that have been referred to *Cyclinella* are discussed, and those from the fossil record are listed.

INTRODUCTION

Panamic province members of the venerid genus *Cyclinella* have been a particular puzzle. Olsson (1961) described one new species, *C. jadisi,* and listed four others—*C. subquadrata* from northwestern South America, *C. saccata* from the Gulf of California to Panama, *C. ulloana* from the Gulf of California, and *C. singleyi* from the Gulf of California to Peru. Keen (1971) listed *Cyclina producta* Carpenter from Panama as a *Cyclinella,* along with the same five taxa as Olsson. She also mentioned *C. kroeyeri,* occurring from Peru to Chile, beyond the southern limit of her book, bringing the number of species to seven. In his checklist, Bernard (1983) also listed these seven.

Previous reviews that include species of *Cyclinella* are those of Reeve (1850), Sowerby (1852), Dall (1902b, 1903), Palmer (1927–1929), Hertlein & Strong (1948), Keen (1958), Olsson (1961), Keen (1971), and Fischer-Piette & Vukadinovic (1972). The characters given by Hertlein & Strong (1948), Olsson (1961), and Keen (1971) for differentiating the taxa of the genus, and the information on the distributions of eastern Pacific species, are inaccurate and contradictory.

The purposes of the present study were to assess the correct identity of the species of *Cyclinella* inhabiting the eastern Pacific and to accurately document their differentiating characters and distributions.

* Mailing address: 891 San Jude Avenue, Palo Alto, California 94306-2640 USA; also Research Associate, Santa Barbara Museum of Natural History and Los Angeles County Museum of Natural History; e-mail: gene.coan@sierraclub.org.

FORMAT

In the following treatment, each valid taxon is followed by a synonymy, information on type material and type localities, notes on distribution and habitat, and additional discussion.

The synonymies include all major accounts about the species, but not most minor mentions in the literature. The entries are arranged in chronological order under each species name, with changes in generic allocation from the previous entry, if any, and other notes given in parentheses.

The distributional information is based on Recent specimens I have examined. Fossil occurrences are taken from the literature.

References are provided in the Literature Cited for all works and taxa mentioned.

The following abbreviations for institutions are used in the text: BM(NH), British Museum (Natural History) collection, The Natural History Museum, London, England; CAS, California Academy of Sciences, San Francisco, California, USA; LACM, Natural History Museum of Los Angeles County, California, USA; USNM, United States National Museum collection, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; UMML, University of Miami Marine Laboratory, Rosenstiel School of Marine and Atmospheric Sciences, Miami, Florida, USA; Skoglund Collection, collection of Carol Skoglund, Phoenix, Arizona, USA.

MORPHOLOGICAL CHARACTERS

In their key to *Cyclinella,* Hertlein & Strong (1948:179) used inflation and the more vertically directed pallial sinus to separate *C. singleyi* (here *C. producta*) from other species, as well as lunule shape, which I do not find di-

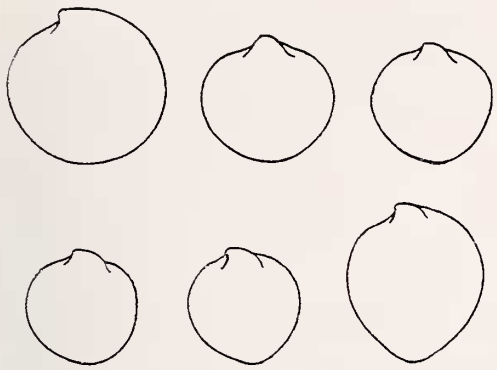


Figure 1. Copy of Fischer-Piette & Vukadinovic's (1972) figure 4, showing the variability in outline of *Cyclinella tenuis*.

agnostic. Subsequent couplets in their key used variable shape characters and non-diagnostic aspects of pallial sinus form. In his key to the genus, Olsson (1961:262) used maximum size as the first couplet to separate *C. singleyi* from everything else. While true, this is a useless character for small specimens. In his second couplet, variable, subjective shape characters were used.

Some aspects of shell shape are of some importance in differentiating the three species. Fischer-Piette & Vukadinovic (1972) showed that the Caribbean *C. tenuis* has a significantly variable outline (Figure 1, a copy of their fig. 4). While *C. subquadrata* has a similarly variable outline, the other two eastern Pacific taxa are much less plastic, and differ in specific ways from *C. subquadrata* in spite of its variability. The most important shape character proves to be the degree of inflation of the shell and of the beaks. Shell sculpture and the distinctness of the lunule are not useful characters, in spite of their mention in some species descriptions. Shell color is characteristic of one taxon. The hinge does not provide many significant characters, most elements varying within each species in similar ways; the direction of the posterior cardinal teeth is minimally helpful. Internally, the direction of the pallial sinus (defined by a line bisecting it) and the partially discontinuous anterior leg of the pallial sinus are distinct in one taxon. The position of the posterior adductor muscle scar relative to the hinge plate also differs among the species. The size measurements made are shown in Figure 2. The most important differentiating characters are given in Table 1.

TAXONOMIC DISCUSSION

Cyclinella Dall, 1902

Cyclinella Dall, 1902a:44. Type species (subsequent designation: Dall, 1902b:357): *Dosinia* (*Artemis*) *tenuis* Récluz, 1852:250–252. Recent, western Atlantic.

Shell ovate; length generally equal to or slightly greater than height. Sculpture of fine commarginal striae. Lunule evident, weakly outlined; escutcheon absent. Pallial sinus short to moderate length, of medium width, and directed toward beaks, toward anterior adductor muscle scar, or between them. Three cardinal teeth in each valve; no lateral teeth; anterior cardinals thin; central cardinals of medium width to broad; posterior cardinals of medium width to thin, elongate, that in right valve bifid. With a deep pit of variable size on hinge plate near anterior end of ligament.

The type species of this genus has generally been regarded as having been established by original designation (as, for example, Keen, 1969:681). However, the wording in Dall (1902a:44) is ambiguous at best, and he included three species in the genus: *C. tenuis* (Récluz, 1852), *C. subquadrata* (Hanley, 1844), and his new *C. singleyi*. The type species was established as being the first of these only by the subsequent designation in Dall (1902b:357).

Table 1.

Key differentiating characters, size, and frequency of eastern Pacific *Cyclinella*

	Inflation	Anterior leg of pallial line	Beaks/Umbones	Pallial sinus points	Posterior adductor scar position	Maximum size, mm	No. of eastern Pacific lots studied
C. jadisi	Flattened, l/w = 2.3–2.7	Continuous (with smaller dorsal scars)	Low, purplish brown	Between anterior adductor and umbones	Close to hinge plate	70.1	28
C. producta	Inflated, l/w = 1.5–1.7	Discontinuous scars	Inflated, white	Toward umbones	More distant from hinge plate	43.3	70
C. subquadrata	Moderately inflated, l/w = 1.9–2.3	Continuous (with smaller dorsal scars)	Moderately inflated, white	Between anterior adductor and umbones	More distant from hinge plate	81.3	169
						Total lots:	267

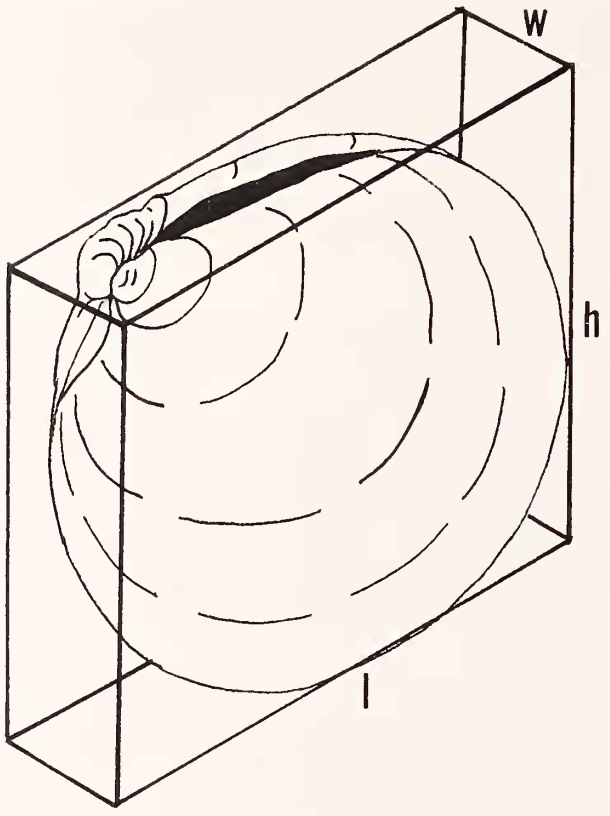


Figure 2. Positions of measurements made of *Cyclinella*—length (l), height (h), and width (w).

This genus, thus far known only from the Americas, is most similar to *Dosinia* Scopoli, 1777:399, differing from it in having thinner shells, lacking a lateral tooth in the left valve, and having less pronounced commarginal sculpture. Unlike some species of *Dosinia,* the lunule is shallow, and there is no escutcheon. *Cyclinella* is similar to *Dosinia* in having an oval shell, and the pallial sinuses of many species of *Dosinia* are also anterodorsally directed (Fischer-Piette & Delmas, 1967: for example, their pls. 13–15).

Several nominal species of *Cyclinella,* as well as many species of *Dosinia,* were originally proposed in *Artemis* Conrad, 1832:20, a widely used misspelling of *Arthemis* Poli, 1791:252, 258, which is an objective synonym of the subgenus *Dosinia* (*Pectunculus*) da Costa, 1778:183 (Keen, 1969:680). (*Artemis* is also *non* Kirby & Spence, 1828, vol. 3:248, a butterfly genus.)

Because species of *Cyclinella* have relatively thin shells, they require care in handling and packing. Many museum specimens have been cracked or broken by careless handling.

The anatomy of the western Atlantic *Dosinia concentrica* (Born, 1778:58) was investigated by Castro Guéron & Santos Coelho (1989), who illustrated the fused siphons of this species (their figs. 8, 9, p. 19). From dried animals in three eastern Pacific lots of *Cyclinella subquadrata,* it is apparent that this genus also has fused siphons (Skoglund Collection, Bahía San Carlos, Sonora, Mexico; Skoglund Collection, Juncalito, Baja California Sur, Mexico; CAS 117652, Bahía de los Angeles, Baja California, Mexico). Based on dried specimens of *Cyclinella,* Dall (1903:1284) described the foot as being small, pointed, and triangular.

Cyclinella has been placed in the subfamily Cycllininae Frizzell, 1936b:64[1] (as, for example, Keen, 1969:681). Harte (1998) demonstrated that the type genus of this subfamily, *Cyclina* Deshayes, 1850:623,[2] is instead more likely to belong in the Chioninae Frizzell, 1936b:65,[1] and she suggested that *Cyclinella* might instead belong in either the Clementiinae Frizzell, 1936b: 64,[1] or the Tapetinae Deshayes, 1853:4, 159, *ex* Gray ms. In contrast, I believe that a relationship to the Dosininae Deshayes, 1853:3, 5, *ex* Gray ms, is more likely. In addition to the shared characters mentioned above, *Cyclinella* and *Dosinia* share a deep pit on the hinge plate near the beaks. Dall (1902a, b) suggested a relationship of *Cyclinella* to the unique European type species of *Mysia* Lamarck, 1818:543, *M. undata* (Pennant, 1777:81 in quarto ed., p. 95 in octavo ed., pl. 55, fig. 51, as *Venus*), the anatomy of which was discussed by Ansell (1961:509–511). *Mysia* also has an orbicular shape, a thin shell, and a dorsally directed pallial sinus. However, it has long, separate siphons and only two cardinal teeth in the right valve. As a result, many authors have placed *Mysia* in the Petricolidae (for example, Keen, 1969:689). Only the addition of anatomical and biochemical characters will resolve the question of the relationships among these genera.

Cyclinella jadisi Olsson, 1961

(Figures 3, 16)

Cyclinella jadisi Olsson, 1961

Olsson, 1961:264, 516, pl. 43, fig. 2; Keen, 1971:179, 180, fig. 429; Fischer-Piette & Vukadinovic, 1972:147.

Type material and locality: ANSP 218900, holotype; length, 61.7 mm; height, 59.1 mm; width, 26.6 mm (Figure 3). UMML 30.11167, paratypes, 1 pair, 4 valves—pair, length, 67.9 mm; right valve, length, 70.1 mm; left valve, 62.5 mm; left valve, 41.3 mm; left valve, 36.6 mm. Palo Seco, Panama (9.0°N); Stewart Jadis, collector.

Description: Shell ovate, length equal to or slightly greater than height (l/h = 1.0–1.1; n = 8); anterior end rounded; posterior end rounded to subtruncate; flattened (l/w = 2.3–2.7; mean, 2.5; n = 7); beaks low, not inflated.

[1] The earlier appearance of these family-group names in a 1936 abstract (Frizzell, 1936a:415) are *nomina nuda* because there are no descriptions (ICZN Code Art. 13.1).

[2] The type species of *Cyclina* is *Venus sinensis* Gmelin, 1791: 3285, by the subsequent designation of Dall (1902b:348).

Figure 3. *Cyclinella jadisi* Olsson, 1961. Holotype of *C. jadisi*; length=61.7 mm.

Exterior surface with a thin, light tan periostracum; umbones purplish brown, rarely white. Interior white, often pinkish tan dorsally. Anterior end of pallial line continuous, with a series of smaller scars above it; pallial sinus directed to between anterior adductor muscle scar and umbones; posterior adductor muscle scar positioned closer to hinge plate than in other species (Figure 16). Posterior cardinals straight. Length to 70.1 mm (UMML 30.11167, a paratype).

Distribution and habitat: From the head of the Gulf of California at Bahía Cholla, Sonora, Mexico (31.4°N) (Skoglund Collection), south to Playas and Salitro, Guayas Province, Ecuador (2.7°S) (Skoglund Collection), from the intertidal zone to 31 m (mean 12.7 m; n = 15); the only bottom types noted on labels are sand and mud. This is the least common of the three eastern Pacific species; I have seen only 28 lots, including the types.

Discussion: This species is sympatric with the more common *Cyclinella subquadrata* throughout the Panamic province, although the two have rarely been obtained from the same station. It is most easily distinguished by its flatter shape and purple beaks.

This species seems very similar to *Cyclinella harrisi* Palmer, 1927, described from the Springvale Miocene of Trinidad, which also has a flattened form (original measurements: l = 62 mm; h = 57 mm; w = 20 mm). Only a closed pair was figured by Palmer (1927).

Cyclinella producta (Carpenter, 1856)

(Figures 4, 5, 17)

Cyclina producta Carpenter, 1856

Carpenter, 1856:161; Carpenter, 1857a:284, 305; Römer, 1860:159; Dall, 1902b:392 (*Cyclinella*); Keen, 1958:

138; Palmer, 1963:308, 394, pl. 64, figs. 10–13; Keen, 1971:179, 180, fig. 430.

Cycliuella singleyi Dall, 1902

Dall, 1902a:44; Dall, 1902b:392, 404, 411, pl. 15, fig. 3; Hoffstetter, 1952:30; Keen, 1958:138, 139, fig. 309; Olsson, 1961:264, 516, pl. 43, fig. 5, 5a; Keen, 1971: 179, 180, fig. 432; Fischer-Piette & Vukadinovic, 1972: 147.

Type materials and localities: *C. producta*—BM(NH) 19621112, holotype, pair; length, 40.4 mm; height, 40.1 mm; width, 26.7 mm (Figure 4). Panama Bay, Panama (approximately 9.0°N); Thomas Bridges, collector.

C. singleyi—USNM 108817, **lectotype** (here designated), pair; length, 39.9 mm; height, 39.3 mm; width, 24.3 mm (Figure 5). USNM 880621, paralectotype, pair; length, 36.7 mm. Delta of Río Yaqui, Sonora, Mexico (27.7°N); J.A. Singley, collector. The lectotype selected is the largest specimen and that figured by Dall (1902b).

Description: Shell subquadrate-ovate, length equal to or slightly greater than height (l/h = 1.0–1.1; n = 10); anterior end sharply rounded; posterior end subtruncate; inflated (l/w = 1.5–1.7; mean 1.6; n = 10); beaks inflated, prominent. Exterior surface of unworn specimens with a thin, tan periostracum. Interior white, sometimes with a light pink flush. Anterior end of pallial line composed of a series of mostly discontinuous scars; pallial sinus directed toward umbones. Posterior adductor muscle scar positioned well below hinge plate (Figure 17). Posterior cardinals curved ventrally. Length to 43.3 mm (ANSP 155502; La Union, El Salvador).

Distribution and habitat: Laguna Ojo de Liebre (Scammons), Pacific coast of Baja California Sur (27.8°N) (CAS 117653), into and throughout the Gulf of California, to its head at Bahía Cholla, Sonora (31.4°N) (Skoglund Collection), Mexico, south to Puerto Pizarro, Tumbes Province, Peru (3.5°S) (UMML 30.11148, 30.11158, 30.11162; LACM 72–84), and probably to Punta Picos, Tumbes Province, Peru (3.5°S) (UMML 30.1115, fragments). Aside from beach drift, all records are from intertidal zone mudflats. I have seen 70 lots, including the types.

This species has been recorded from the late Pleistocene terraces at Newport Bay, Orange County, California (LACM 62-2; Kanakoff & Emerson, 1959:22).

Discussion: It is surprising that workers have not recognized the similarity of Carpenter's *Cyclina producta* to Dall's *Cycliuella singleyi*, particularly after its holotype was illustrated by Palmer (1963).

Cyclinella subquadrata (Hanley, 1844)

(Figures 6–15, 18)

Artemis subquadatra Hanley, 1844

Hanley, 1844:11, pl. 15, fig. 39; 1856:357; Hanley, 1845: 11–12; Reeve, 1850:pl. 3, fig. 15; Sowerby, 1852:661–662, pl. 141, fig. 27; Deshayes, 1853:31 (*Cyclina*); Carpenter, 1857b:62–63; Römer, 1860:159; Pfeiffer, 1869: 115–116, pl. 28, figs. 10–12; Dall, 1902b:391 (*Cyclinella*); Lamy, 1910:89; Bosworth, 1922:177, pl. 25, fig. 15; Hertlein & Strong, 1948:180–181; Keen, 1958:138, 139, fig. 310; Olsson, 1961:263, 528, pl. 55, fig. 2; Keen, 1971:179, 180, fig. 433; Fischer-Piette & Vukadinovic, 1972:141–146, figs. 7–12.

Venus (*Artemis*) *kroeyeri* Philippi, 1847

Philippi, 1847:87 (as "*kröyeri*"); Philippi, 1848:26 (= 78), pl. 7, fig. 9; Deshayes, 1853:32 (*Cyclina*); Hupé, 1854: 338; Römer, 1860:159; Pfeiffer, 1869:116–117, pl. 31, figs. 1–3; Dall, 1902b:391 (*Cyclinella*); Riveros-Zuñiga & Gonzales Reyes, 1950:124–125; Soot-Ryen, 1957:8; Keen, 1958:136, 137, fig. 307; Fischer-Piette & Vukadinovic, 1972:144, 147.

Artemis macilenta Reeve, 1850

Reeve, 1850:pl. 9, fig. 51; Sowerby, 1852:662, pl. 154, fig. 32; Deshayes, 1853:31–32 (*Cyclina*); Keen, 1971: 180 (as possibly = *Cyclinella subquadrata*).

Arthemis saccata Gould, 1851

Gould, 1851:91; Gould, 1853:396–397, pl. 15, fig. 2; Adams, 1852a:400 (1852b:275) (as "*Artemis*"); Deshayes, 1853:32 (*Cyclina*); Carpenter, 1857b:62 (as = *C. subquadrata*); Römer, 1860:159; Johnson, 1964:144; Olsson, 1961:263–264, 513, 515, 516, pl. 40, fig. 6; pl. 42, fig. 4, 4a; pl. 43, figs. 4, 4a, 6, 6a; Keen, 1971: 179, 180, fig. 431.

Cycliuella galera Pilsbry & Olsson, 1941

Pilsbry & Olsson, 1941:66, 78, 79, pl. 12, fig. 1, pl. 19, fig. 4.

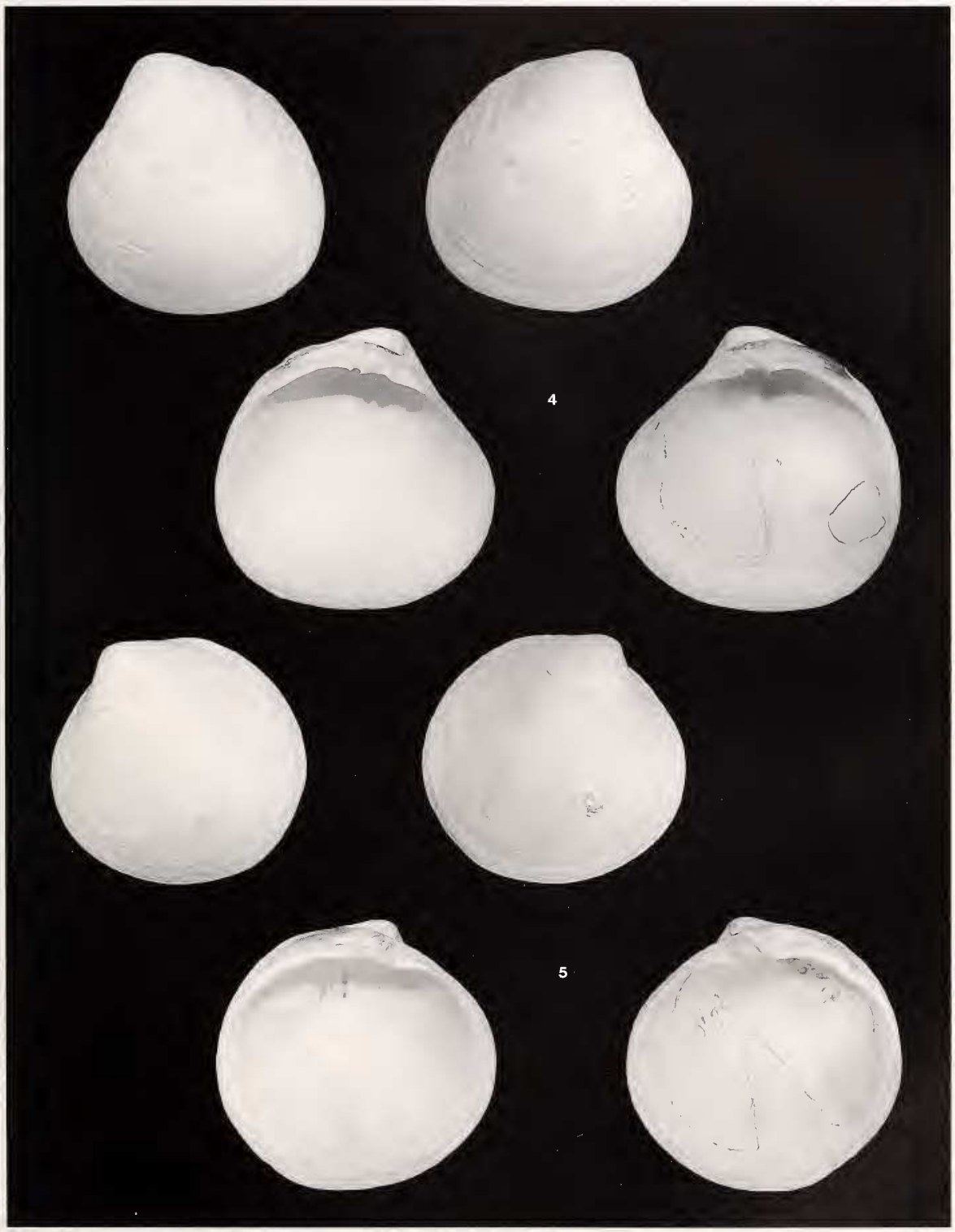
Cyclinella kroeyeri ulloana Hertlein & Strong, 1948

Hertlein & Strong, 1948:179–180, 197, pl. 2, figs. 5–7; Keen, 1958:137, fig. 307a; Olsson, 1961:264, 516, pl. 43, fig. 3; Keen, 1971:180, 181, fig. 434; Fischer-Piette & Vukadinovic, 1972:147.

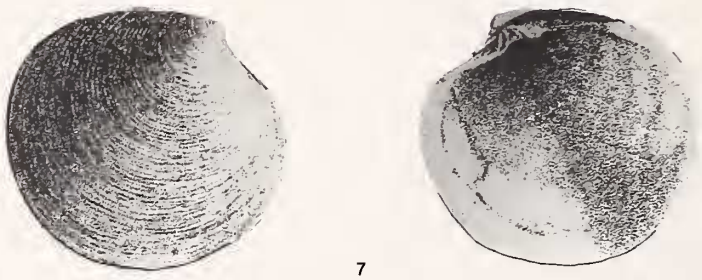
Type materials and localities: *A. subquadrata*—BMNH 1998196/1, **lectotype** (here designated); length, 35.1 mm; height, 32.1 mm; width, 16.8 mm (Figure 6). BMNH 1998196/2, paralectotype; length, 26.4 mm. Santa Elena, Guayas Province, Ecuador (2.2°S); Hugh Cuming, collector. Hanley (1845) gave a length of 44.5 mm, but this specimen has not been detected in the BMNH. The lectotype selected is the larger of the two extant type specimens.

V. (*A.*) *kroeyeri*—Lost. Not in the Museum für Naturkunde, Berlin (M. Galubrecht, e-mail, 4 May 1999), nor in the Museo Nacional de Historia Natural, Santiago, Chile (D. Frassinetti, e-mail, 24 August 1999). Philippi's 1848 figure is 27.6 mm in length (Figure 7). "Chile, Peru." There are no subsequent records of *Cyclinella* from Chile; its occurrence there in the Recent fauna is unlikely, although the genus is known as a Pliocene or Pleistocene fossil at Mejillones, Antofagasta Province, Chile (23.1°S) (see below). The type locality is here clarified as being Paita, Piura Province, Peru (5.1°S), from where the species is known (CAS 117661).

A. macilenta—Lost. The original figure measures 20 mm in length (Figure 8). (Isla) Salango, Manabí Province, Ecuador (1.6°S); Hugh Cuming, collector.



Figures 4, 5. *Cyclinella producta* (Carpenter, 1856). Figure 4. Holotype of *Cyclina producta;* length = 40.4 mm. Figure 5. Lectotype of *Cyclinella singleyi* Dall, 1902; length = 39.9 mm.



Figures 6–8. *Cyclinella subquadrata* (Hanley, 1844). Figure 6. Lectotype of *Artemis subquadrata;* length, 35.1 mm. Figure 7. Figures of *Venus* (*Artemis*) *kroeyeri* Philippi, 1848, from Philippi (1848); length = 27.6 mm. Figure 8. Original figure of *Artemis macilenta* Reeve, 1850; length = 20 mm.

A. saccata—MCZ 169358, holotype, pair; length, 39.8 mm; height, 36.6 mm; width, approximately 20.6 mm (Figure 9). The right valve is intact but cracked; the left valve is now missing its umbones and hinge. Mazatlán, Sinaloa, Mexico (23.2°N); Thomas P. Green, collector.

C. galera—ANSP 13698, holotype, left valve; length, 54.2 mm; height, 52.9 mm; width, approximately 12.5 mm (Figure 10). Puerto Jama (as "Jame"), Manabi Province, Ecuador (0.2°S); Jama Formation; Pliocene.

C. kroeyeri ulloana—CASGTC 06559, holotype, left valve; length, 77.5 mm; height, 73.9 mm; width, approximately 19.3 mm (Figure 11). CASGTC 065560, paratype, left valve; length, 65.4 mm. CASGTC 065561, paratypes; left valve, length, 29.7 mm; right valve, 22.9 mm. Bahía Santa Inéz, Baja California Sur, Mexico (26.9°N), 46 m, sand; Templeton Crocker Expedition station 143-D-4, April 13, 1936.

Description: Shell variable in shape, ovate to subquadrate, length equal to or slightly greater than height (l/h = 1.0–1.1; n = 10); anterior end evenly to sharply rounded; posterior end rounded to subtruncate; posterior slope set off from central slope by a slightly raised ridge in some specimens; moderately inflated (l/w = 1.9–2.3; mean, 2.0; n = 10); beaks only moderately inflated. Exterior surface with a thin, tan periostracum. Interior white. Anterior end of pallial line continuous, with a series of smaller scars above it; pallial sinus directed between anterior adductor muscle scar and hinge. Posterior adductor scar positioned well below hinge plate (Figure 18). Posterior cardinals often curved ventrally (straight in some specimens). Length to 81.3 mm (LACM 152576; Cerro Azul, Lima Province, Peru; Figure 16).

Distribution: From the east side of Isla Cedros, Baja California (28.1°N) (LACM 71–92), into and throughout the Gulf of California, to its head at Golfo de Santa Clara, Sonora (31.7°N) (Skoglund Collection), Mexico, south to Cerro Azul, Lima Province, Peru (13.1°S) (LACM 152576; Figure 16). Aside from beach drift, this species has been recorded from the intertidal zone to 75 m (mean 29.2 m; n = 95). This is the most common species in collections; I have seen 169 lots, including the types.

This species has been recorded from the late Pleistocene terraces at Newport Bay, Orange County, California (LACM 66-2; Kanakoff & Emerson, 1959:22); on a Pleistocene terrace at Mancora, Tumbes Province, Peru (Bosworth, 1922:177); from the Pliocene or Pleistocene at Mejillones, Antofagasta Province, Chile (D. Frassinetti, e-mail, 24 August 1999); and from the Pliocene at Puerto Jama, Manabí Province, Ecuador (type locality of *C. galera*). The record of "*Cyclina* near *C. subquadrata*" from the Pleistocene of Barbados by Trechmann (1933:36, pl. 4, fig. 4) is more likely to have been based on *C. tenuis* (Récluz, 1852).

Discussion: After considerable sorting and resorting of the available material, I have come to the conclusion that there is but a single taxon represented by the species names *subquadrata, kroeyeri, macilenta, saccata, galera,* and *ulloana.* Indeed, the original figures and the extant type material of these nominal taxa do not represent the extremes of the variability of this species. The types of *A. subquadrata* from Ecuador are small, typical specimens. The original figures of *V. kroeyeri,* presumably from Peru, are very similar. The original figure of *A. macilenta,* also from Ecuador, depicts a specimen that is somewhat narrower anteriorly and expanded posterodorsally, a morphology matched by available specimens. The type specimen of *A. saccata,* from Mexico, is a close match to the type material of *A. subquadrata,* and the type material of *C. ulloana* is simply a large specimen from the Gulf of California. The type specimen of the Ecuadorian Pliocene *C. galera* is thick, with a short anterior end and an expanded posterodorsal margin, and is matched by a Recent specimen from Ecuador (Figure 14).

Four additional specimens of this species are figured here to show the variability in shape exhibited by this species (Figures 12–15). Figure 12 is a typical specimen from the head of the Gulf of California, such as the type material of *A. saccata* and *C. ulloana.* Figure 13 is a large, oval specimen from Panama Bay among the material identified by Olsson (1961) as *C. saccata.* Figure 14 is an Ecuadorian Recent specimen similar in shape to the Pliocene holotype of *C. galera.* Figure 15 is the southern record and size record of the species, a specimen with a subquadrate outline.

The later-named western Atlantic *Cyclinella tenuis* (Récluz, 1852) is virtually identical to *C. subquadrata* and shows the same pattern of variation in outline. None of the characters that differentiate the three eastern Pacific taxa serves to differentiate them, and I have been unable to find other distinguishing characters. However, the western Atlantic form does not attain as large a size (largest specimen seen: CAS 117674; 41.5 mm; Ponta de Praia, Santos, São Paulo Province, Brazil). This relationship merits additional investigation.

REJECTED RECORDS AND RELATED SPECIES

Artemis turgida Reeve, 1850 (pl. 9, fig. 53), was described from an unknown locality. A slip was later added to the holotype, BMNH 1998194, with a locality of "La Union or Conchagua, Central America, A. Sallé." Based on a photograph supplied by the BMNH, this species was placed in *Cyclinella* by Fischer-Piette & Vukadinovic (1972:149–151, figs. 13–17). However, examination of the holotype, a pair (length, 28.8 mm; height, 26.7 mm; width, 14.9 mm), shows it to be a *Dosinia,* with an anterior lateral tooth in the left valve, a defined escutcheon, strong commarginal sculpture, and a large, deep pallial sinus. It is more likely that this specimen came from the Indo-Pacific province, because there is no similar eastern Pacific species of *Dosinia.* For example, based on the illustration, it seems very

Figures 9–11. *Cyclinella subquadrata* (Hanley, 1844). Figure 9. Holotype of *Arthemis saccata* Gould, 1851; length = 39.8 mm. Figure 10. Holotype of *Cyclinella galera* Pilsbry & Olsson, 1941; length = 54.2 mm. Figure 11. Holotype of *Cyclinella kroeyeri ulloana* Hertlein & Strong, 1948; length = 77.5 mm.

Figures 12–15. *Cyclinella subquadrata* (Hanley, 1844). Figure 12. SBMNH 345458; Golfo de Santa Clara, Sonora, Mexico; *ex* Skoglund Coll.; intertidal mud; length = 49.8 mm. Figure 13. UMML 28-2260; Panama Bay at 8.4°N, 79.7°W, in 11–15 m, Panama; length = 71.2 mm. Figure 14. SBMNH 345459; Playas, Guayas Province, Ecuador; trawled; *ex* Skoglund Coll.; 71.2 mm. Figure 15. LACM 152576; Cerro Azul, Lima Province, Peru; length = 81.3 mm.

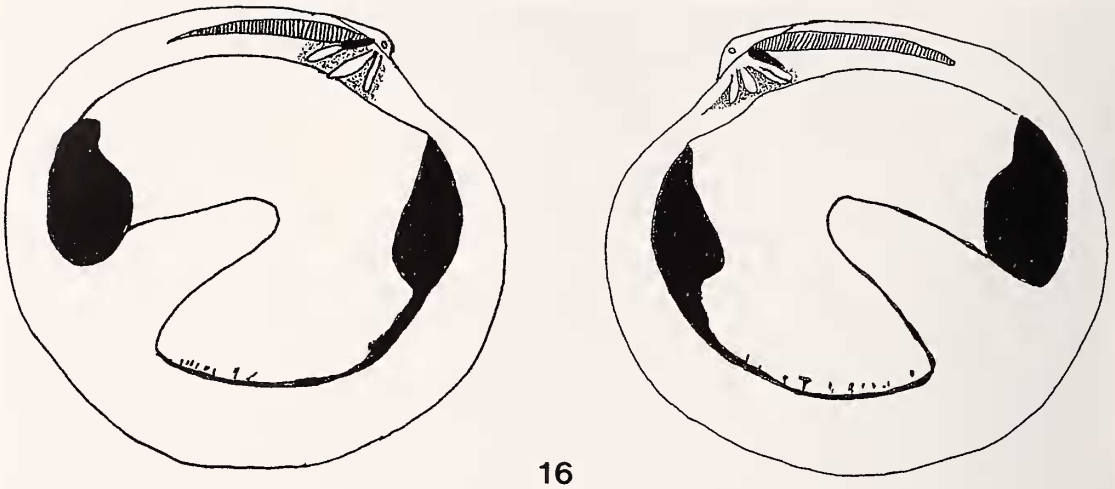
similar to *Dosinia* (*Dosinella*) *malzinii* Fischer-Piette & Vukadinovic, 1972 (pp. 78, 79, pl. 14, figs. 9–13), described from New Caledonia.

Artemis inflata Sowerby, 1852 (pp. 661, pl. 141, fig. 25), described from an unknown locality and figured only in external view. No type material has been located in the BMNH collection (J. D. Taylor, in Fischer-Piette & Vukadinovic, 1972:148), and it must be regarded as a *nomen dubium* because no diagnostic characters are available.

Artemis tenuis Sowerby, 1852 (p. 661, pl. 141, fig. 22), was described from an unknown locality and figured only in external view. In his original description, Sowerby cited Reeve's figure of *Artemis turgida* (see above). Type material has not been located in the BMNH collection. Two specimens in a lot labeled as possibly being type specimens (BMNH 19990484) are both larger than Sowerby's 16.5-mm-long figure, and neither match it in shape. The larger (length, 22.2 mm) is a small individual of the eastern Pacific *Cyclinella producta* (Carpenter, 1856), and the smaller (length, 20.7 mm) is a specimen of the European *Mysia undata* (Pennant, 1777). Under these circumstances, *Artemis tenuis* Sowerby must either be regarded as a synonym of *Dosinia turgida* (Reeve, 1850) or as a *nomen dubium*. [Because Sowerby's monograph has not been precisely dated, it must be considered to have been issued on 31 December; thus, even if *A. tenuis* Sowerby were considered to be a *Cyclinella*, it would not preoccupy *C. tenuis* (Récluz, 1852), which dates from 1 September.]

Cyclina fragilis Römer, 1860 (pp. 160, 161), has been regarded as a synonym of *Cyclinella tenuis* (Dall, 1902b: 373; Fischer-Piette & Vukadinovic, 1972:139). The distribution of *C. tenuis* was discussed by Boss & Wass (1970); it occurs from Virginia to Brazil. Wright & Moore (1970) studied aspects of its ecology and reproduction. This species is also discussed by Palmer (1927: 408, 409, pl. 24, figs. 3, 5, 18).

Dosinia (*Artemis*) *tenuis* Récluz, 1852 (pp. 250–252, pl. 10, fig. 1, 1′), is the western Atlantic type species of *Cyclinella*. The type specimen of this species is not present in the Muséum d'Histoire Naturelle in Paris (P. Bouchet,



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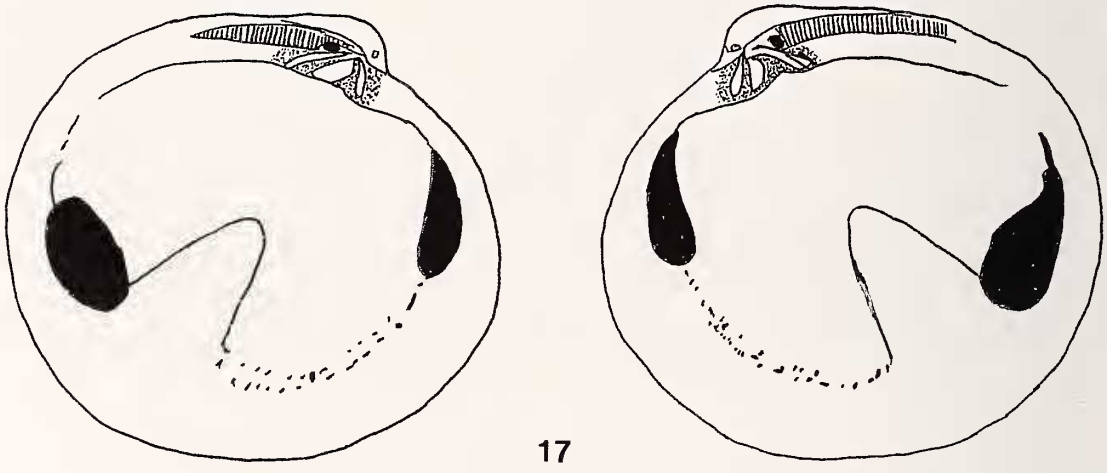

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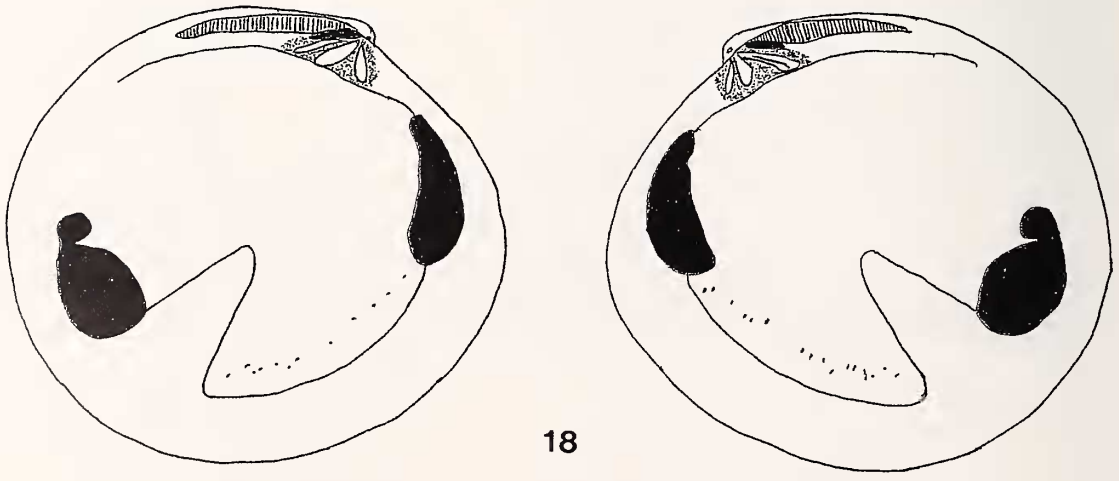

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e-mail, 7 May 1999). The Muséum d'Histoire Naturelle in Geneva holds a specimen that could possibly be the type, although it is slightly larger (length, 38.5 mm) than the originally stated dimensions (length, 35 mm), and it is not accompanied by any convincing documentation (Y. Finet, e-mail, 10 & 12 May 1999).

Fischer-Piette & Vukadinovic (1972:148–149) speculated that *Dosinia minor* Deshayes, 1863 (p. 12, pl. 2, figs. 1–3), described from l'île de La Réunion in the Indian Ocean, might be a *Cyclinella.* It is more likely that it was correctly placed in *Dosinia* in the first place, particularly given its broad, elongate anterior hinge plate.

Fischer-Piette & Vukadinovic (1972:149) allocated *Lucina elegans* H. Adams, 1871 (p. 791), to *Cyclinella.* This species, described from the Red Sea, has proven instead to be a synonym of *Wallucina erythraea* (Issell, 1869: 84–85, pl. 1, fig. 9, as *Lucina*) (Oliver, 1992:98, pl. 20, fig. 3a, b). *Lucina elegans* was allocated to *Cyclina* and reported from southeast Asia by Lynge (1909:251–252, pl. 5, figs. 14, 15). Lynge's record may be based on some other lucinid, his illustration shows an orbicular shell with fine radial sculpture.

FOSSIL TAXA OF *CYCLINELLA*

There are several names for fossil *Cyclinella,* particularly from Miocene strata. Given the variability in shape of the Recent *C. tenuis* and *C. subquadrata,* it seems likely that there remain more names than species, even with the synonymies that have thus far been suggested.

Cyclinella cyclia (Guppy, 1866:582, 590, pl. 26, fig. 15a, b; as *Dosinia*) is widely reported in the Miocene of the Caribbean. *Cyclinella gatunensis* Dall, 1903:1285, pl. 52, fig. 18; *C. cyclia domingensis* Pilsbry & Johnson, 1917:200 (see also Pilsbry, 1922:424, 435, pl. 47, fig. 8); and *C. venezuelana* H. K. Hodson, in F. Hodson et al., 1927:59, pl. 34, figs. 3, 4, have been regarded as synonyms (Maury, 1925:151–153, pl. 26, fig. 4; Woodring, 1982:696–697, pl. 120, figs. 18, 19; pl. 123, figs. 3, 4) (see also Palmer, 1927:405–407; 1929:pl. 24, figs. 2, 7, 12, pl. 25, figs. 6, 7, 15, 16).

Cyclinella falconensis H. K. Hodson, in F. Hodson et al., 1927:59, 148, pl. 34, fig. 2, was described from the Oligocene and Miocene of Venezuela.

Cyclinella plasiatenuis Woodring, 1925:158–159, 219, pl. 21, figs. 10, 11, was described from the Bowden Miocene of Jamaica (see also Palmer, 1927:408; 1929:pl. 24, figs. 1, 4).

Cyclinella subquadrata quitana Olsson, 1922:243, 287, pl. 31, fig. 8, was described from the Gatun Miocene of Costa Rica (see also Palmer, 1927:408; 1929:pl. 25, fig. 3).

Cyclinella beteyensis Olsson, 1922:242–243, 287, pl. 31, fig. 2, was described from the Gatun Miocene of Costa Rica, and subsequently recorded from Panama (Olsson, 1964:59, 213, pl. 6, fig. 9) (see also Palmer, 1927:407; 1929:pl. 25, fig. 8).

Cyclinella harrisi Palmer, 1927:407–408; 1929:pl. 45, figs. 6, 7, was described from the Springvale Miocene of Trinidad.

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Figures 16–18. Diagrammatic internal views of eastern Pacific species of *Cyclinella,* showing hinge, pallial sinus, and adductor muscle scars. Figure 16. *Cyclinella jadisi;* SBMNH 345460; Bahía San Carlos, Sonora, Mexico; 15–30 m; length = 39.4 mm. Figure 17. *Cyclinella producta;* SBMNH 345461; Bahía Cholla, Sonora, Mexico; *ex* Skoglund Coll.; intertidal zone; length = 37.6 mm. Figure 18. *Cyclinella subquadata;* CAS 117637; Guaymas, Sonora, Mexico; dredged; 50.0 mm.

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